

CLAIMS

- 1 1. An audio system including a plurality of channels, comprising:
2 a listening area, comprising a plurality of listening spaces;
3 a directional audio device, positioned in a first of said listening spaces, close to a
4 head of a listener, for radiating first sound waves corresponding to components of one
5 region for receiving the said channels; and
6 a nondirectional audio device, positioned inside said listening area and outside
7 said listening space, distant from said listening space, for radiating sound waves
8 corresponding to components of a second of said channels.
- 1 2. An audio system in accordance with claim 1, wherein said directional audio
2 devices comprise a plurality of acoustic drivers, said acoustic drivers positioned and
3 arranged to radiate sound waves that interfere destructively at a first predetermined
4 location in space and to interfere nondestructively at a second predetermined location in
5 space.
- 1 3. An audio system in accordance with claim 2, wherein said first predetermined
2 location is in a first listening space and said second predetermined location is in a second
3 listening space.
- 1 4. An audio system in accordance with claim 2, wherein said first predetermined
2 location is proximate a first volume for receiving a first ear of a listener and wherein said
3 second predetermined location is proximate a second volume for receiving a second ear
4 of said listener.
- 1 5. An audio system in accordance with claim 1, wherein said listening area
2 comprises a theater and said first and second listening spaces comprise seating locations
3 within said theater.
- 1 6. An audio system in accordance with claim 1, wherein said listening area
2 comprises a vehicle passenger compartment and said listening locations comprise seating
3 locations within said vehicle passenger compartment
- 1 7. A method for operating an audio system for radiating sound into a first
2 listening space and a second listening space, said first listening space adjacent said second
3 listening space, comprising:
4 receiving first audio signals;

5 transmitting first audio signals to a first transducer;
6 transducing, by said first transducer, said first audio signals into first sound waves
7 corresponding to said first audio signals;
8 radiating said first sound waves into a first listening space;
9 processing said first audio signals to provide delayed first audio signals, wherein
10 said processing comprises at least one of time delaying said audio signals and phase
11 shifting said audio signals;
12 transmitting said delayed first audio signals to a second transducer;
13 transducing, by said second transducer, said delayed first audio signals into
14 second sound waves corresponding to said delayed first audio signals; and
15 radiating said second sound waves into said second listening space.

1 8. Between an adjacent pair of theater seats, a directional acoustic radiating
2 device.

1 9. Apparatus in accordance with claim 8, wherein said directional acoustic
2 radiating device is constructed and arranged for radiating first sound waves
3 corresponding to first audio signals and for radiating second sound waves corresponding
4 to second audio signals;

5 and for radiating third sound waves for opposing said first sound waves;

6 and for radiating fourth sound waves for opposing said second sound waves.

1 10. Apparatus in accordance with claim 8, one of said theater seats being below a
2 normal position of a head of an occupant, and a second of said theater seats being below a
3 normal position of a head of an occupant, wherein said directional acoustic radiating
4 device is substantially equidistant from said first seat normal position and said second
5 seat normal position.

1 11. An audio mixing system, comprising a playback system comprising
2 directional acoustic radiating devices local to the head of an operator;

3 said playback system further comprising acoustic radiating devices non-
4 local to said head of said operator.

1 12. An audio mixing system in accordance with claim 11, further comprising a
2 video system for displaying video images so that said operator can mix audio signal that
3 are transducible to acoustic energy having audio cues consistent with a sound source

4 location coincident with associated video images.

1 13. An audio mixing system in accordance with claim 12, wherein said video
2 system is a three dimensional video system.

1 14. A directional acoustic radiating device comprising:

2 an enclosure;

3 a first directional subarray comprising two elements, mounted in said enclosure,
4 said first two elements for coaxing to directionally radiate first sound waves, each of said
5 first two elements having an axis, said axes of said first two elements defining a first
6 plane;

7 a second directional subarray comprising two elements, mounted in said
8 enclosure, said second two elements for coaxing to directionally radiate second sound
9 waves, each of said second two elements having an axis, said axes of said second two
10 elements defining a second plane;

11 wherein said first plane and said second plane are nonparallel.

1 15. A directional acoustic radiating device in accordance with claim 12, said axis
2 of one element of said first directional subarray and said axis of one of said second
3 subarray defining a third plane; and

4 said axis of the other element of said first array and said axis of the other element
5 of said second subarray defining a fourth plane;

6 wherein said third plane and said fourth plane are nonparallel.

1 16. A method for radiating audio signals comprising:

2 radiating sound waves corresponding to first audio signals directionally to a first
3 listening space;

4 radiating sound waves corresponding to second audio signals directionally to a
5 second listening space; and

6 radiating sound waves corresponding to third audio signals nondirectionally to
7 said first listening space and said second listening space.

8 17. A directional acoustic array system, comprising:

9 a plurality of directional arrays, each comprising a first acoustic driver and a
10 second acoustic driver;

11 wherein said first acoustic drivers of said plurality of directional arrays are

12 arranged collinearly in a first line; and

13 wherein said second of said acoustic drivers of said plurality of directional arrays
14 are arranged collinearly in a second line;

15 wherein said first line and said second line are parallel.

1 18. A line array system comprising:

2 an audio signal source for providing a first audio signal;

3 a first line array comprising a first plurality of acoustic drivers mounted
4 collinearly in a first straight line;

5 a second line array comprising a second plurality of acoustic drivers mounted
6 collinearly in a second straight line, parallel with said first straight line;

7 signal processing circuitry coupling said audio signal source and said first line
8 array for transmitting said first audio signal to said first plurality of acoustic drivers;

9 said signal processing circuitry intercoupling said audio signal source and said
10 second plurality of acoustic drivers for transmitting said first audio signal to said second
11 plurality of acoustic drivers;

12 wherein said signal processing circuitry is constructed and arranged to reverse the
13 polarity of said first audio signal transmitted to said second plurality of drivers.

1 19. A line array system in accordance with claim 16, wherein said signal processing
2 circuitry is further constructed and arranged to change the relative phase between said audio
3 signal transmitted to said plurality of said acoustic drivers and said audio signal transmitted
4 to said second plurality of acoustic drivers.

1 20. An audio-visual system for creating audio-visual playback material, comprising:

2 a source of three dimensional video images;

3 an audio mixing system for modifying audio signals constructed and arranged
4 to provide modified audio signals that are transducible to acoustic energy having locational
5 audio cues consistent with a sound source at a predetermined distance from a listener
6 location; and

7 a storage medium for storing said three dimensional video images and said
8 modified audio signals for subsequent playback.

1 21. An audio-visual system in accordance with claim 20, said audio mixing system
2 further constructed and arranged to modify said audio signals so that said audio signals are

transducible to acoustic energy having locational audio cues consistent with a sound source at a predetermined azimuthal position relative to said listener.

22. An audio-visual system in accordance with claim 21, said audio mixing system further constructed and arranged to modify said audio signals so that said audio signals are transducible to acoustic energy having locational audio cues consistent with a sound source at a predetermined elevation relative to said listener.

23. An audio-visual system in accordance with claim 20, said audio mixing system further for modifying said audio signals so that said audio signals are transducible to acoustic energy having locational audio cues consistent with a sound source at a predetermined elevation relative to said user.

24. An audio-visual system in accordance with claim 20, said audio mixing system including acoustic radiating devices local to said listener and acoustic radiating devices non-local to said listener.

25. An audio-visual playback system for playing back audiovisual material, said audio-visual material including a sound track having audio signals, said playback system comprising:

- a display device for displaying three dimensional video images;
- a seating device for a viewer of said audio-visual material; and
- an electroacoustical transducer, in a fixed local orientation relative to said seating device, for transducing said audio signals into acoustic energy corresponding to said audio signals so that said acoustic energy includes locational audio cues consistent with an audio source at a predetermined distance from said viewer.

26. An audio-visual playback system in accordance with claim 25, said electroacoustical transducer further for transducing said audio signals into acoustic energy having locational audio cues consistent with an audio source at a predetermined azimuthal position relative to said listener.

27. An audio-visual playback system in accordance with claim 26, said electroacoustical transducer further for transducing said audio signals into acoustic energy having locational audio cues consistent with an audio source at a predetermined elevation relative to said listener.

1 28. An audio-visual playback system in accordance with claim 25, said
2 electroacoustical transducer further for transducing said audio signals into acoustic energy
3 having locational audio cues consistent with an audio source at a predetermined elevation
4 relative to said listener.

1 29. An audio-visual playback system in accordance with claim 25, wherein said
2 electroacoustical transducer is a directional transducer.

1 30. An audio-visual playback system in accordance with claim 29, wherein said
2 directional transducer is a directional array.

1 31. An audio-visual playback system for playing back audio-visual material, said
2 audio-visual material including a sound track having audio signals including locational cues
3 consistent with an audio source at a predetermined distance from a viewer, said playback
4 system comprising:

5 a display device for displaying three dimensional video images;

6 a seating device for said viewer of said audio-visual material; and

7 a directional electroacoustical transducer for transducing said audio signals
8 into acoustic energy corresponding to said audio signals and for radiating directionally
9 toward an ear of a viewer seated in said seating device, said acoustic energy.

1 32. An audio-visual playback system in accordance with claim 31, said directional
2 electroacoustical transducer further for transducing said audio signals into acoustic energy
3 having locational audio cues consistent with an audio source at a predetermined azimuthal
4 position relative to said viewer.

1 33. An audio-visual playback system in accordance with claim 32, said directional
2 electroacoustical transducer further for transducing said audio signals into acoustic energy
3 having locational audio cues consistent with an audio source at a predetermined elevation
4 relative to said viewer.

1 34. An audio-visual playback system in accordance with claim 31, said directional
2 electroacoustical transducer further for transducing said audio signals into acoustic energy
3 having locational audio cues consistent with an audio source at a predetermined elevation
4 relative to said viewer.

1 35. An audio-visual playback system in accordance with claim 31, said audio-visual
2 playback system further comprising a plurality of seating devices for a plurality of viewers

3 and a plurality of electroacoustical transducers, wherein each of said electroacoustical
4 transducers is in a local fixed orientation relative to a one of said plurality of seating devices.

1 36. An audio-visual playback system in accordance with claim 35, wherein said
2 plurality of directional transducers are directional arrays.

1 37. In an audio system comprising a directional acoustic device for transducing audio
2 signals to acoustic energy having a directional radiation pattern and a nondirectional acoustic
3 device for transducing audio signals to acoustic energy having a nondirectional radiation
4 pattern, a method for processing audio signals including spectral components having
5 corresponding wavelengths in the range of the dimensions of the human head comprising:
6 receiving first audio channel signals, said first audio channel signals including head related
7 transfer function (HRTF) processed audio signals;

8 receiving second audio channel signals, said second audio channel signals
9 containing no HRTF processed audio signals;

10 directing said first audio channel signals to said directional acoustic device;

11 and

12 directing said second audio channel signals to said non-directional acoustic
13 device.

1 38. An audio playback system in accordance with claim 37 wherein said directing
2 said first channel signals comprises directing said first channel to an interference device.

1 39. In an audio system comprising a directional acoustic device for transducing audio
2 signals to acoustic energy having a directional radiation pattern and a nondirectional acoustic
3 device for transducing audio signals to acoustic energy having a nondirectional radiation
4 pattern, a method for processing audio signals including spectral components having
5 corresponding wavelengths in the range of the dimensions of the human head comprising:

6 receiving audio signals that are free of HRTF processed audio signals;

7 processing said received audio signals into first audio signals including HRTF
8 processed audio signals and audio signals not including HRTF processed audio signals; and

9 directing said HRTF processed audio signals so that said directional acoustic
10 device receives HRTF processed audio signals and so that said non-directional acoustic
11 device receives no HRTF processed audio signals.

1 40. A audio playback system in accordance with claim 39, wherein said directing
2 comprises directing said HRTF processed audio signals so that an interference type
3 directional acoustic device receives HRTF processed audio signals.

1 41. A method for mixing input audio signals to provide a multi-channel audio signal
2 output, said multi-channel signal output comprising a plurality of audio channels including
3 spectral components having corresponding wavelengths in the range of the dimensions of the
4 human head, said method comprising:

5 processing said input audio signals to provide a first of said output channels
6 including head related transfer function (HRTF) processed audio signals; and

7 processing said input audio signals to provide a second of said output channels
8 free of head related transfer function (HRTF) processed audio signals.